Foraging patterns and behaviours, body postures and movement speed for goannas, *Varanus gouldii* (Reptilia: Varanidae), in a semi-urban environment

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Abstract

Two Gould's goannas (*Varanus gouldii*) were intensively observed in the semi-urban environment of Karrakatta Cemetery, Perth, Western Australia. After emerging and basking to increase their body temperature, they spent most of their time out of their burrows foraging, primarily in leaves between grave covers, and under trees and shrubs. Mean speed of movement between specific foraging sites was 27.6 m min^{-1}, whereas the overall mean speed while active was only 2.6 m min^{-1} because of their slower speeds while foraging. A number of specific body postures were observed, including; vigilance, walking, erect, and tail swipes. Specific feeding and avoidance behaviours were also recorded, along with the influence that two species of birds had on their selection of foraging sites.

Introduction

Our knowledge of foraging habits, patterns, home range and activity area size, posture, and behaviour for large goannas has been extended since the early work of Cowles (1930) with *V. niloticus*, and Green & King (1978) with *V. rosenbergi*. Recent comprehensive studies include those by Auffenberg (1981a,b; 1988; 1994) for *V. komodoensis*, *V. bengalensis* and *V. olivaceus*, Auffenberg *et al.* (1991) for *V. bengalensis*, Daltry (1991) for *V. salvator*, and Weavers (1993) for *V. varius*. General descriptions of varanid locomotion, postures and foraging behaviour are given by King & Green (1993 a,b). However, there remains a paucity of data concerning the behaviours, body postures and movement patterns of small and medium sized varanid lizards.

Pianka (1994) reports that Australian desert goannas, such as *V. gouldii*, are exceedingly wary, unapproachable, and unobservable; this consequently makes it very difficult to study their use of time and space, foraging behaviour and body postures. Because *V. gouldii* at Karrakatta Cemetery have learned to accommodate to the presence of people, this site provides a unique opportunity for a study of their behaviour and foraging patterns that is not possible in more remote locations.

This study is the third in a series (Thompson 1992, 1994) on the movements, behaviours and ecology of *V. gouldii* at Karrakatta Cemetery, Perth, Western Australia. The earlier papers report on the daily distance travelled, foraging areas and the size of the activity area during the breeding season. The primary objective of this study was to examine in detail the behaviours, postures and preferred micro-habitat foraging sites for two particular individual *V. gouldii*.

Methods

Study Site

Karrakatta Cemetery (115° 47' E, 31° 55' S) is located within the Perth metropolitan area, approximately 4 km west-south-west of the city centre. It has 53 ha allotted to burial plots and another 53 ha to roads, ornamental gardens and buildings. The cemetery is planted with a range of exotic shrubs and trees, with many of the northern, central and eastern areas being grassed. There are numerous rose gardens to the south and east of the main entrance, which are located on the northern boundary (see Thompson 1992, 1994). A nature reserve of approximately 7 ha is located on the south-eastern boundary. The study site was located in the southern section of the cemetery (Fig 1).

Monitoring procedures

A miniature radio-transmitter with a battery life of approximately 140 days (11 g mass; TX1 1C temperature-pulse, Bio-Telemetry Tracking) was attached to the lateral aspect of the base of the tail for seven *V. gouldii* in early November, 1993. The radio transmitter was sewn into a denim harness that was glued with Selleys 'kwik-grip' to the skin of the goanna's tail to encircle the tail for a length of approximately 50 mm. Each goanna was located prior to observations commencing each day with a Bio-tel RX3 receiver operating in the 150-151 MHz band in conjunction with a 3EY directional antenna. The behaviour and daily movements of five of these *V. gouldii* were initially monitored to choose two goannas that readily adapted to being observed. Behavioural observations over five weeks commenced on these two *V. gouldii* [#1, a female, with a body mass of 330 g, snout-to-vent length (SVL) of 314 mm; and #2, a female, with a body mass of 348 g and SVL of 300 mm] on 1 December 1993 and concluded on 18 January 1994. This study was conducted in conjunction with a study that continuously

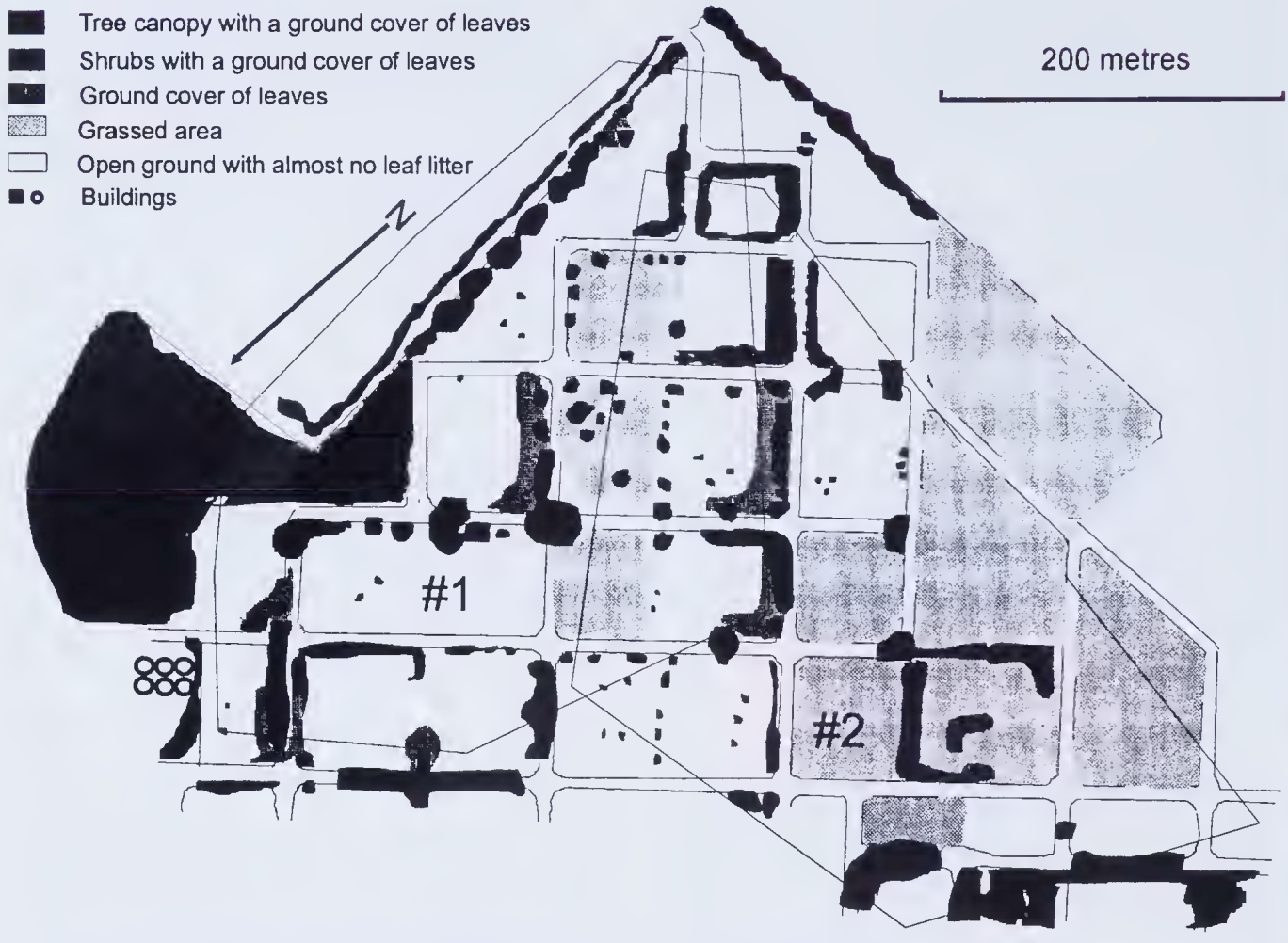

Figure 1. Karrakatta Cemetery, showing the study site vegetation and *V. gouldii* activity areas.

monitoring of the body temperature of these *V. gouldii* over a number of months using temperature sensitive transmitters attached to the lizards and a data-logger connected to a large stationary antenna.

During the first week of observation, each goanna was initially monitored from a distance of approximately 50 m. After this adjustment period, most observations were then carried out from a distance of 15 to 35 m. On numerous occasions, the observed *V. gouldii* moved toward the observer, reducing the distance to observer to less than 5 m, and on a few occasions to less than 2 m. This suggests that the presence of an observer had a minimal influence on their behaviour. The data from the first week of observation of the two *V. gouldii* were not analysed, as this period allowed these two *V. gouldii* to adjust to the continued presence of an observer.

Two well trained observers spent a total of 131 hours watching and recording data for these two *V. gouldii* or waiting for them to emerge from their burrows, but they never spent more than half a day observing one goanna, to minimise any impact that these observations might have had on their normal behaviour. The recording procedures of the two observers were checked every couple of days during the first two weeks to ensure consistency of observations and recording of data.

Foraging, movement and posture recording procedures

Observations for each goanna on the choice of foraging site, general habitat, extent of exposure to the sun and distance moved were recorded for the previous nine minute interval in the categories shown in Table 1. Movement behaviour for each nine minute period was classified into seven categories (Table 1). Data reported for the micro-habitat of foraging sites, general habitat type selected, extent of exposure to the sun, and distance travelled, include only the time between when the goanna commenced foraging to when it either returned to a burrow or observations ceased (but excludes the time between when the goannas emerged from their overnight burrow and when they were first observed basking in the sun to increase their body temperature T_b). Goannas often moved through various sites during the nine minute period. The predominant environment for the period is the one reported. The number of times that *V. gouldii* #1 was seen to capture a prey item was also recorded, and is reported as the mean number of minutes between successful strikes. In addition, observers recorded the time when the goanna produced a scat, its behaviour and when the two *V. gouldii* were harassed by birds. Observers also noted the feeding and digging behaviours for these two goannas.

In late December, 1993, both goannas were recorded by video camera for a total of 6 hours, (four hours for

Table 1. Alternatives used to classify the foraging sites, general habitat, extent of exposure to the sun and movement behavior.

Micro-habitat foraging sites	General habitat type selected	Extent of exposure to the sun	Movement behaviour
Between grave covers	Between graves	Total sun	Emerging from an overnight burrow
Leaves under trees or shrubs	On top or the side of graves	¾ sun	Basking but not moving
Under grave covers	Under grave covers	½ sun	Basking and moving
Leaves in an open area	Grassed areas	¼ sun	Moving about outside a grave cover
Grass in an open area	On the road verge	All of the time in the shade	Moving under a grave cover
Grass under trees or shrubs	Treed areas	Under grave cover or in a burrow	Stationary and looking
	In the yards of adjacent houses		Avoidance (people, dogs, birds, vehicles)
	Up a tree		
	In the nature reserve (heavily grassed with ≈ 50% tree canopy)		

one and two hours for the other), over a four day period and body postures were drawn from these video images. Reference to this visual record was also used to clarify the written descriptions of each observer for postural, feeding and digging behaviours.

The linear distance that each of the two *V. gouldii* moved during each nine minute observation period was estimated by recording the number of grave lengths and widths (3.6 m and 1.8 m respectively) that the goanna had passed during the period. This distance is a slight underestimate of the total distance moved due to the meanderings of the goannas while they foraged. However, as the goannas mostly moved between grave covers or between foraging sites, their actual movement path was generally a series of near linear movements. These were summed for each period. For example, if a goanna was to circumambulate a grave cover the total linear distance would be approximately 10.8 m presuming it moved midway between adjacent grave covers. From these data, the mean distance travelled per minute was calculated. The average speed of movement between foraging sites was estimated by recording the time, to the nearest 0.1 second, that it took for a *V. gouldii* to cover a known distance (*e.g.* length of a grave plot) over thirteen trials. A trial score was only used if the goanna was moving in a straight line past two points whose

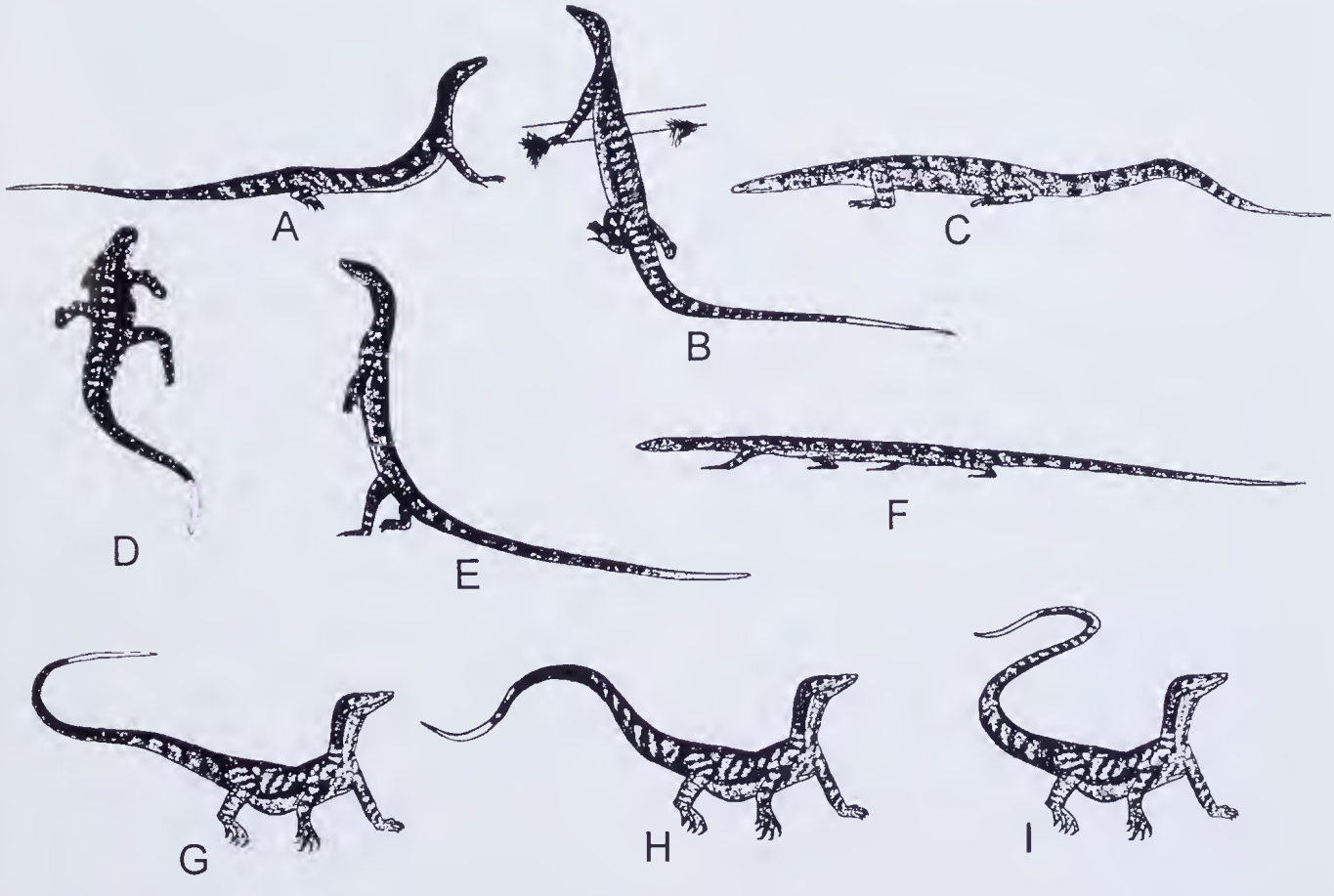

Figure 2. Body postures adopted by *V. gouldii* at Karrakatta Cemetery. A: lying on a grave cover with the posterior abdomen flattened onto the grey concrete surface and the head and neck raised; B: on the side of a grave cover with the abdomen dorso-ventrally flattened and directed towards the sun; C: cloaca and anterior proportion of the tail being wiped on the ground after extruding a scat; D: lateral sigmoidal trotting action shown while walking; E: standing erect by balancing on the hind feet and tail; F: walking with only the distant end of the tail dragging on the ground; G, H, & I: tail swipes with non-aggressive posture.

distance apart could be measured, it did not stop to forage or view the surrounds, had not been obviously disturbed, and was not avoiding being seen or attacked.

The ambient temperature (T_a), one metre above the ground, in the shade of a tree, was recorded every nine minutes, for the duration of the study using a Data-flow logger and a calibrated temperature sensitive probe attached to a transmitter. Occasional measurements of the temperature in the shade about one metre above the ground, surface soil in full sunlight, under a grave cover and on top of a grave cover in the sun were recorded to examine the range of thermal environments available to a goanna at any one time.

Results and Discussion

Emergence and responses to ambient temperature

The goannas were seen to emerge from their overnight retreat on eight occasions between 0700 hours and 0945 hours. The mean T_a on emerging was 23.4 (± se 0.98) °C. On 15 occasions, the *V. gouldii* had emerged unseen before 0900 hours, and on another 11 occasions the goannas had not emerged by 0945 hours. As has been reported for other varanids (Sokolov *et al.* 1975; King 1980; Weavers 1983), these two goannas would most often poke their heads out of their burrows for a while before their whole bodies emerged in the sun, suggesting that they are initially warming their heads possibly to increase the functioning of their nervous system (King & Green, 1993a). Once the *V. gouldii* had moved from under the grave cover and onto the top of it, they would dorso-ventrally flatten and lower their abdomen onto the grave cover so as to expose the greatest body surface area for both radiative and conductive heat gains (Fig 2A). They would remain constantly vigilant during this period (2 - 35 minutes) with head and neck held aloft, until they moved off to forage.

After emerging and basking, foraging most often commenced in an area of full sunlight, and the goannas would often seek partially-shaded or fully-shaded areas to forage as the ambient temperature increased. A mean ambient temperature of 25.8 °C (± se 0.75, n = 14) was recorded for the first nine minute period that the goanna spent in either in ¾ shade or a full shade. *V. komodoensis* are reported to adopted a similar strategy of moving from sunny areas into the shade as the ambient temperature increases (Auffenberg 1981a). One *V. gouldii* (#1), while vigorously digging out a spider's hole in full sun-light (ambient T_a of 27.3 °C, 10:30 hours), stopped on three occasions to open its mouth to gular pant. When it finally had caught the spider, it moved quickly to the closest shade. The gular panting by *V. gouldii* in this situation was probably an indication that the goanna was approaching its critical maximum T_b in response to solar radiative heat gain and perhaps metabolic heat production from the vigorous activity. Hyoid breathing (or gular panting) occurs at a T_b of approximately 39 °C for *V. rosenbergi* (King 1977, p.126) and 41 °C for *V. griseus* (Vernet *et al.* 1988b). Auffenberg (1981a) reports that gular panting indicates that *V. komodoensis* is approaching its critical maximum T_b.

Measurements of the temperature in the shade about one metre above the ground, surface soil in full sunlight, under a grave cover and on top of a grave cover in the sun were occasionally recorded to examine the range of thermal environments available to a goanna at any one time. After mid-morning when the surface soil and grave covers had heated up, a wide variation in thermal environments were most often recorded (*e.g.* on December 24 at 1015 hours, air temperature was 27 °C, under grave cover temperature was 24.1 °C, surface soil temperature was 39.6 °C and on top of a grave cover it as 46.4 °C) enabling the goanna to effectively regulate its body temperature by choosing a particular thermal environment.

Foraging site selection

The general habitats and foraging micro-habitats selected by the two goannas were determined for periods of 41.05 and 26.55 hours respectively (Table 2). The activity area for each goanna (Fig 1) was determined by the smallest convex polygon that incorporated all of the locations that each lizard was found. The activity area of *V. gouldii* #1 (7.8 ha, excluding the bitumen road and the area outside the cemetery boundary) was approximately 61% open ground with almost no leaf litter, 16% tree canopy with a ground cover of leaves, 10% grassed area, 11% leaf litter on open ground, and 2% shrubs with a leaf litter ground cover (grave covers were included in the total space calculations according to the immediate surrounds). The activity area of *V. gouldii* #2 (8.5 ha) was 42% open ground with almost no leaf litter, 34% grassed area, 7% a tree canopy and ground cover of leaves, 12% leaf litter on open ground and 5% shrubs with a ground cover of leaves (Fig 1). The activity areas for these two goannas were substantially larger than were recorded for six other female *V. gouldii* (2.29 ± se 0.23 ha, range 1.6 - 3.28 ha, mean mass = 380 g) measured during the previous breeding season (Thompson, 1994). It is not known if there was a real difference in activity area sizes, or whether the presence of an

Table 2. The percentage of time spent by two *V. gouldii* range of habitat types and selected microhabitat foraging sites. The data reported comes from 65 hours of observations and only includes the time between when *V. gouldii* commenced foraging until the goannas either returned to a burrow or observations ceased.

Habitat type	Percentage of time *V. gouldii* #1	*V. gouldii* #2
Between graves	35.6	39.7
On top or the side of graves	27.5	35.0
Under grave covers	12.2	9.9
Grassed areas	9.9	5.5
On the road verge	4.8	4.2
Treed areas	3.6	4.7
In yards of adjacent houses	3.2	0.0
In nature reserve	3.1	0.0
Up a tree	0.0	1.0
Micro-habitat foraging sites within activity area		
Between grave covers	47.7	77.9
Leaves under trees or shrubs	19.7	9.9
Under grave covers	13.7	4.2
Leaves in an open area	9.8	5.6
Grass in an open area	8.1	2.4
Grass under trees or shrubs	0.9	0.0

observer increased the size of these activity areas, or the difference was due to the different nature of the data used to calculate the activity areas. In the earlier study, only one location was recorded for each goanna each day, and the total activity area was calculated from the smallest convex polygon that included all recorded locations. In this study, the location of each goanna was known for up to half a day over a period of approximately six weeks. Continuous observations are more likely to determine the real boundary of a goanna's activity area than would single daily observations, a factor not taken into account by the 'direct' polygon method used by Thompson (1994). Perhaps a better comparison might be with the activity area sizes calculated using the Jennrich & Turner (1969; females mean activity area of 3.91 ha ± se 0.36) approach, or the weighted ellipse (Samuel & Garton 1985: females mean activity area of 3.1 ha ± se 0.33).

Both goannas spent the highest proportion of their foraging time (47.7% for #1 and 77.9% for #2) in the leaf litter between grave covers, without a tree or shrub canopy. These areas were estimated to be only 11 and 12% respectively of their total activity areas (Fig 1). The leaf litter between grave covers had often accumulated to a depth greater than 50 mm and many of the grave covers contained a hole under the edge, into which the goanna could retreat. It could be speculated that these two goannas selectively chose these area to forage because the leaf litter provided a good food source (Marginal Value Theorem; Charnov 1976) and the grave covers were suitable protection from predators. The two other most-foraged habitats were the leaf litter under trees and shrubs (#1, 19.7% and #2, 9.9%), and under grave covers (#1, 13.7% and #2, 4.2%). Trees and shrubs with a ground cover of leaf litter under the canopy comprised approximately 18 and 12% respectively of the activity areas of these two goannas. The shrubs and trees provided both shade in the hotter parts of the day, which enable the varanids to continuing foraging within their eccritic body temperature range, camouflage protection and a source of food in the leaves.

On one occasion, *V. gouldii* #2 climbed up in to a shrub that was approximately 1500 mm high and wide, and was observed to search the foliage, for a period of over 23 minutes. During this time, it climbed onto and searched almost every branch in the shrub that would support its body mass. Pianka (1970) reported that *V. gouldii* sought refuge in trees, but Thompson & Homer (1963) suggest that *V. g. flavirufus* was not arboreal. Thompson (1994) reports finding four *V. gouldii* up trees in Karrakatta Cemetery with 'no evidence to suggest that they had been chased into this situation'. He speculated that they might have been thermoregulating or foraging. In this study, the arboreal *V. gouldii* was actively foraging.

Foraging patterns and behaviours

V. gouldii #1 was seen to catch 64 prey items (spiders, insects and skinks) during a period of 35.5 hours of observation over 17 days. This was equal to one prey item being captured every 33.3 minutes. One scat was normally produced by each goanna each morning within an hour of commencing to forage. At the completion of excreting the scat, the *V. gouldii* would raise the middle and distal end of its tail, and drag its cloaca and the proximal end of the tail on the ground for 8-12 cm (Fig 2C).

The two *V. gouldii* appeared to use both visual and auditory cues to detect their prey from a distance. When a goanna approached a patch of leaves, it would slow its forward speed of movement, move its head and neck slowly from side-to-side, using the snout to shift leaf litter while flicking the tongue in and out. The front feet were often used to scratch leaves away or dig into the ground for prey items. The use of the flicking forked tongue was taken as an indication that the lizard was using olfactory cues to find prey (Pianka 1982; Auffenberg 1984; Cooper 1989; Garrett & Card 1993). Once a prey item had been located, the *V. gouldii* would normally persist searching until the prey was captured, or in excess of five minutes. On one occasion, *V. gouldii* #2 was monitored while foraging in an exposed location (full sun-light), on a grassed area adjacent to a water pipe; having detected a prey item, it searched a small area for over 20 minutes before catching a small skink, then quickly moved to a shaded and more protected area. *V. gouldii* #1, on two occasions, was observed to jump approximately 300 mm into the air to try to catch an insect flying over is head; on both occasions it was unsuccessful.

On five occasions, *V. gouldii* were observed to dig a triangular shaped hole, with the apex adjacent to a spider hole, to excavate the spider. The goanna used its front feet to dig the sand from the hole and the back feet to remove the small pile of sand that accumulated at the top of the hole. The back feet were never observed to assist in digging the hole itself. All prey that were caught were quickly oriented in the mouth and swallowed, without signs of chewing. The goanna would often wipe the sides of their jaws on the ground after swallowing their prey.

Influence of birds on foraging sites

The foraging of these two *V. gouldii* at Karrakatta Cemetery was influenced by the rainbow bee-eater (*Merops ornatus*) and the red wattlebird (*Anthochaera carunculata*). A bee-eater was seen to swoop on a *V. gouldii* on 13 different occasions, and chase it away from their nesting holes (into the soft sand areas of the cemetery). The goanna would lower its head during the final moments of such an attack, to avoid contact, and would quickly retreat to a more secure location. Bee-eaters were observed to actually contact a goanna on five occasions. On one occasion, the goanna ran approximately 70 m after being harassed to find protection under a grave cover. The red wattlebird was also observed to swoop on a goanna on 12 occasions, contact with the lizard's head was seen on one occasion. It appeared that goannas had learnt to distinguish the particular calls of the red wattlebird and the rainbow bee-eater from other noises, as they would adopt a vigilant posture upon hearing their calls and move away from the direction of the call or under a shrub or tree to avoid being swooped on. Poiani (1991) reports another wattlebird (*Manorina melanophrys*) responding to the presence of *V. gouldii* with an alarm call.

Movement speeds and distance travelled while foraging

Little is known of the speed at which varanids forage, although the total distance moved in a given period is known for a number of large varanids. For example, Stebbins & Barwick (1968) report a 4.2 kg *V. varius* to travel a total distance of 2.9 km over a five day period in November, and Weavers (1993) reports the same species to travel up to 1.63 km day^{-1} in south-eastern New South Wales. Vernet *et al.* (1988b) report *V. griseus* in the north-western Sahara desert to cover between 0.1 and 2.5 km day^{-1}; Pianka (1970, 1971, 1982) reports following *V. gouldii* for 'over a mile', *V tristis* for 'nearly a mile' and *V. eremius* for 'up to a kilometre' in a day, in semi-arid environments of Western Australia. Auffenberg (1981a) reports the much larger *V. komodoensis* to travel as much as 10 km day^{-1}, with a mean of 1.8 km day^{-1}, while Alberts (1994) reports *V. albigularis* in Namibia to travel as much as 4 km day^{-1} during the mating season. *V. gouldii*, with a body mass of less than 600 g (measured in a previous year during October and November) travelled an appreciably shorter distance per day (mean 158 m day^{-1}; Thompson 1992). In this study of two *V. gouldii*, the average speed was 2.6 m min^{-1} while foraging; *V. gouldii* #1 covered an estimated total distance of 7010 m in 42 hours of activity time (a mean speed of movement of 2.78 m min^{-1}), while *V. gouldii* #2 covered an estimated total distance of 2238 m in 23.5 hours of activity time (a mean speed of movement of 1.59 m min^{-1}). The speed of movement between foraging patches was considerably higher, at 27.6 m min^{-1} (se = 1.92, range of 18.6 to 40.2 m min^{-1}), which was about ten times the overall mean speed of foraging. Goannas seldom moved in a straight line when moving between foraging sites and when foraging. Therefore, the mean speed of movement between foraging patches and the mean speed of movement while foraging are probably underestimates because the actual distance covered in each trial was greater than the linear distance recorded. However, the underestimation is probably quiet small, because most of the movement by the two goannas occurred between grave covers where circuitous movements are constrained by the walls of the graves. Trials to establish movement speed between foraging sites were conducted adjacent to grave covers of known dimensions.

Body postures

V. gouldii frequently stopped during foraging to adopt a 'vigilant' posture. This posture was characterised by the body remaining motionless, the abdomen held in either a prone or erect position, and the head and neck held high. The goanna would slowly rotate its head a couple of times to give a clear view of the surrounding area, while the posterior part of the abdomen and tail rested on the substrate. When a grave cover was nearby, the goanna would sometimes climb onto the side (Fig 2B) or top of the grave cover during foraging, adopt this vigilant posture, then return to the ground to continue to forage. On a few occasions, a goanna was observed to stand erect, by balancing on the hind legs and tail (Fig 2E). This stance appeared to be prompted by the need to see over some obstruction, as it occurred when the *V. gouldii* were between graves and their vision of the surrounding area was obstructed. A similar erect posture has been reported by Glazebrook (1977) for *V. gouldii* standing erect on its hind legs to obtain a better view of its surrounding. Auffenberg (1981a) reports adult *V. komodoensis* standing erect to take food suspended in the air, and young *V. komodoensis* standing erect to look over tall grass. King & Green (1993a) show a *V. panoptes* in a similar upright stance. These erect stances are different from the bipedal threat displays of *V. mertensi* (Murphy & Lamoreaux 1978), *V. panoptes* (King & Green 1993b, p257; Wilson & Knowles 1992, p318; Bennett 1992), *V. gouldii* (Grigg *et al.* 1985, p vii; Horn 1985) and for several other species (Beste & Beste 1977, p89) where the neck is arched, the gular pouch extended and the goanna hisses while rapidly flicking its tongue in and out. The aggressive body postures reported by King & Green (1993a, b) for varanids generally, Auffenberg (1981a) for *V. komodoensis*, Bennett (1992) for *V. panoptes*, Stanner (1985) for *V. griseus*, Johnson (1976), Murphy & Lamoreaux (1978) *for V. mertensi*, Pianka (1970) and Stirling (1912) for *V. gouldii*, and Daltry (1991) for *V. salvator* were not seen for the *V. gouldii* at Karrakatta Cemetery. Rather, these goannas appeared to adopt an avoidance behaviour when threatened.

Tail swipes (4 and 8 in quick succession) were observed on two occasions. On neither occasion were they associated with an inflated gular pouch and abdomen, or a hissing sound, as reported by King & Green (1993a) to represent an aggressive stance. On the first occasion, *V. gouldii* #1 approached to within a couple of metres of the observer, raised and turned its head slightly to the side and moved its tail from side-to-side four times (Fig 2G, H and I). On the second occasion, *V. gouldii* #2 was digging for prey. I have observed a similar 'tail-swipes' behaviour for a male *V. gilleni* courting a female of the same species. Additional observations are necessary before this behaviour can be accurately interpreted.

V. gouldii are primarily quadrupedal and terrestrial. After they had emerged from their overnight burrow, elevated their T_b, and commenced moving around their foraging site, they were observed to 'drag' a substantial proportion of their tail on the ground. As the morning progressed, the tail was often lifted off the ground, or only the distal 20% was dragged on the ground (Fig 2F). A lateral sigmoidal trotting (diagonally opposite feet advancing together) while walking was often evident (Fig 2D). The head was normally swung slowly from side-to-side, and at the same level as the body (Fig 2F). The walking posture of *V. gouldii* was therefore similar to that described by King & Green (1993a) for varanids generally, and by Auffenberg (1981a) for *V. komodoensis*, except that *V. gouldii* would sometimes lift their tail off the ground while walking and not leave a tail drag mark. The dorsal surfaces of the rear toes were often dragged along the ground extending the length of their spoor, similar to that reported for *V. komodoensis* (Padian & Olsen 1984).

On twelve occasions, *V. gouldii* #1 was observed, while stationary, to raise its tail so that the distal end was vertical. The same tail raising posture was not observed for goanna #2. A similar stance has been reported for *V. tristis* (Christian 1981); its long tail was curled in a long arc so that the tip would almost touch the back of the neck. The role of this body stance is unknown.

Detection by a goanna of a person, dog or other source of potential danger resulted in one of two initial responses. The goanna would either flatten its body on the ground and remain motionless until the source of danger had passed, or it would slowly move behind a nearby object and would remain motionless. Some two to ten minutes later, it would poke its head around the object to determine if the danger had passed. Alternatively, if the goanna had just emerged from a burrow or a burrow was nearby, it would return to this burrow instead of hiding behind an object. *V. gouldii* appeared to run to a burrow only if the source of danger came very close.

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